

PROJECT SCREW-WORM PREDESIGN CONCEPTS FOR THE REARING OF 50 MILLION FLIES PER WEEK

by

Edward J. Kendra



July 1956

CHEMICAL CORPS ENGINEERING COMMAND

Army Chemical Center, Maryland

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BW Plants Div, Directorate for BW Engineering

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ENCR NO. 9, July 56, _____pp-illus-charts-dwgs (Unclassified

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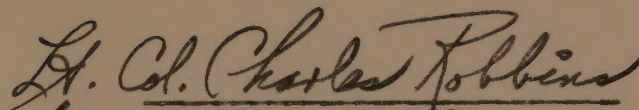
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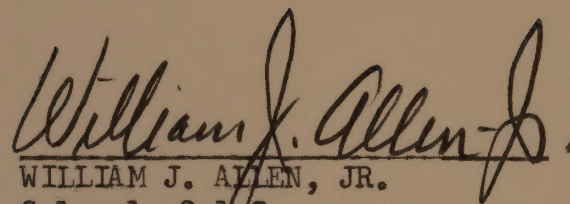
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CHEMICAL CORPS ENGINEERING COMMAND
Army Chemical Center, Maryland

July 1956

PROJECT SCREW-WORM

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SUMMARY

Project "Screw-Worm" resulted from a request by the U.S. Department of Agriculture, Entomology Research Branch, for engineering assistance from the BW Plants Division, Chemical Corps Engineering Command, on the design of a pilot-plant and a large scale plant (50 million flies per week) for rearing screw-worm flies.

This report formalizes a tentative plant design for the production of irradiated "screw-worm" flies, *callitroga hominivorax* (cqrl.). The flies, in the pupal stage, are irradiated in a radio-active chamber and released in the field. The release of the sexually sterile males among the existing natural population is used as the active mechanism for an eradication program. This report is intended to be a starting point or a basis from which to continue definitive drawings, design criteria, and cost estimates. It also points out areas of potentially greatest reduction in cost for further work in research and development.

Separation Sheet

Collection Name: Southeast United States: Screwworm Eradication Program
Records

Item: [Front elevation]

Original location: Box 8, Folder 286 – Project Screw-Worm Redesign Concepts for
the Rearing of 50 Million Flies Per Week, ENCR No. 9

Subject/Series: II.C – Report

New location: Oversize, Box 10, Folder 361 – Project Screw-Worm Redesign
Concepts for the Rearing of 50 Million Flies Per Week, ENCR No. 9

SECTION I. DESIGN CRITERIA

	YIELD		TIME		TEMP	HUMIDITY
	%		days		°F.	%
	Step	Cumm	Step	Cumm		
Pupae for Colony			2	2	80	100
Adults in Colony			8	10	80	80
Egg Laying	100	100	2 hr	0 4	100	100
Eggs Hatched	95	95	1	1 4	80-85	100
Larvae Reared	80	76	4.5	5.5 4	95-100	95-100
Larvae Pupated	95	72	1	6.5 4	80	100
Pupae Held	100	72	5	11.5 4	80	100
Pupae Radiated	98	71	1 hr	12	Ambient	Ambient
Pupae Packed	100	71	1 hr	12	Ambient	Ambient
Pupae Shipped	100	71	1 hr	12	Ambient	Ambient

Product Analysis: Irradiated Males 50%
 Irradiated Females 50%

Packaged on 5th day of 7 day - pupation stage.

Egg laying assumptions: Females lay only once in the process
 Yield 200 eggs average

Weight per Pupae or Fly: 75 mgm = 0.075 gm.

Number Pupae per gm: 13.3

Number Pupae per lb: 6,020

Number Pupae per bag: 130

Media per Pupae: 1.35 cc = 1.39 gm

Ratio weight of media
 to weight of fly: 18.5:1

Operational Summary: 3 shifts (8 hour each), 4 crews, 7 day
 schedule; averaging 42 hours per week,
 per operator.

Designed production:

2 year total: 5,200,000,000 flies in 40,000,000 bags

1 year total: 2,600,000,000 flies in 20,000,000 bags

Weekly av: 50,000,000 flies in 385,000 bags

Daily av: 7,100,000 flies in 55,000 bags

Hourly av: 297,000 flies in 2,280 bags

Average per minute: 4,950 flies in 38 bags

SECTION II. PROCESS DESCRIPTION FOR IRRADIATED SCREW-WORM REARING PLANT

1. Summary

The rearing of the irradiated screw-worm fly includes the hatching of fertile eggs, the growth of the larvae on a meat-blood media, the irradiation of the pupae, and the packaging of the pupae in the dispersal container. The rearing is carried out in a semi-continuous fashion using disposable trays, tubes, and cages in carefully controlled conditions of temperature and humidity. Media is prepared in mixing kettles and then dispensed into trays at various stages during the larvae growth. The self-harvesting larvae are gathered and stored in soil. The larvae pupate within 24 hours, after which they are separated from the soil and permitted to age in tubes. The dormant pupae are irradiated, using a radioactive source, and sent to the packaging room. The pupae are counted, placed in bags, then into cartons ready for shipment by air to distribution centers in an infested area. The flies emerge from the pupae just prior to the dispersion time.

A small portion of the dormant pupae is recycled to the adult colony room for emergence as flies for the production of eggs. These eggs are gathered and then hatched in a laboratory incubator. The larvae are then placed in a small quantity of meat-blood media to start the cycle again.

2. Flow Sheet

a. The following flow sheet illustrates the step-by-step progression of Project Screw-Worm.

b. Flexibility in the operation of this plant is incorporated in the design by the adequate live storage capacity of the conveyor racks in the incubator room. Only three-fourths of the shelves are expected to be utilized during a normal production schedule. Should a breakdown occur or maintenance be required, the rate could be increased to provide up to one-third more capacity in order to maintain the average rate. The design also includes variable speed motors for the conveyor lines. If additional capacity is needed, the first line could be placed in operation for the 24-hour larvae instead of the freshly hatched tiny larvae. The production from this line would fill the remaining one-fourth of the shelves in the conveyor racks. Several additional stations would be required during periods of peak operations.

Separation Sheet

Collection Name: Southeast United States: Screwworm Eradication Program
Records

Item: Project Screw-Worm Equipment Flow Sheet

Original location: Box 8, Folder 286 – Project Screw-Worm Redesign Concepts for
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3. Raw Material Storage

It is proposed that ground horse, beef, or goat (low fat) meat be brought in refrigerated trucks from the meat packing plant. Assuming that 1.35 milliliters of media will be required for the rearing of one larvae, 62,208 pounds of meat will be required per week. This figure may be on the low side, since recent indications showed that about one and one-half milliliters were required; it was not too well established whether this meant per egg started or per larvae hatched. However, it is assumed that as a result of the designed plant and its more uniform environmental conditions, established feed times, and controlled quantities, better media utilization would result.

A one-week supply of meat could be stored in the 860-square-foot or 8,600-cubic-foot refrigerator. The temperature would be maintained at 40° F. using either brine-cooled coils racked against the wall or a unit blower system. The meat would be contained in reusable tote boxes (9 in. h. by 9 in. w. by 18 in. l. = 6.3 gals. = 55 lbs of meat) stacked 3 feet high on 3 ft. by 3 ft. wooden pallets. Each pallet would contain 32 tote boxes containing 1,760 pounds of meat. This would require about 35 pallets, if a one week supply was contemplated. It is intended to store 32 pallets in the refrigerated room, 16 on the main floor and 16 stacked. It was decided to provide a separate platform level for the second tier although it may not be necessary depending upon the strength of the tote boxes. The tote boxes are cleaned and replaced on the pallets via the supply truck. The boxes are filled at the packing house and loaded on the pallets for storage prior to delivery. As soon as the meat is delivered, a forked-truck operator lifts the pallet plus tote boxes containing the ground meat from the truck to the refrigerator room via the loading ramp. It will be assumed that the truck will back into a below-ground-level ramp. This will avoid the need for raising the entire building by 3 to 4 feet in order to accommodate the loading ramps. The lift truck hauls 1,470 pounds of meat (1,760 pounds on one pallet) from the refrigerator room, on the loading dock, to the raised platform outside of the media makeup room ready for charging the media mixer.

The refrigeration system is located in the utility room except for the brine tank, pumps, cooling tower, and cooling condenser. This refrigeration system also maintains the temperature of the bovine blood in two 2,000 gallon horizontal tanks at 40° F. The blood collected at the packing house is brought to the plant in 55-gallon drums, 71 per week. A small amount of citrate, as preservative, is added to the drums as soon as filled at the packing plant. A pump transfers the blood to the storage tanks until ready for use. Formalin (35.3 gals/week) is stored in a drum as received. It would be set upon a rack and dispensed in 0.84 gallon (3,180 cc.) quantities. The honey (146.9 gals./week) is received in 55 gallon drums and also stored on racks. This is dispensed in small quantities to the adult colony room and the packaging room.

The media for the trays in the incubator room is mixed in one of the two 500 gallon media mixers. The schedule calls for one batch per shift or one every four hours.

One batch consists of the following:

Water	1,400 lbs.	or	168 gallons
Formalin	6.4 lbs.	or	3,180 ml
Blood	740 lbs.	or	84 gallons
Meat	1,470 lbs.	or	about 168 gallons
Total	3,610.4 lbs	or	420 gallons

These items are either weighed on a platform balance or measured by a volumetric meter. The media is prepared by thorough mixing at 95° F. in the media tank kept at this temperature by hot water (150° F.) in the jacket. The flow of this water is controlled by the temperature of the media. The media is dispensed by a pump to the media dispensing room adjacent to the incubator room. The empty mixing tanks are carefully washed down and sterilized with free steam after every batch. Two operators plus the forked-truck operator are assigned for the media prep area.

4. Incubation Room

All personnel working with the larvae stage of the process are located in the media dispensing room, adjacent to the main incubation room. This room will be maintained for human comfort and kept as free as possible from the incubator room odors.

For the moment, it will be assumed that a sufficient quantity of tiny larvae from hatched eggs are provided by the laboratory through the double-ended incubators. The 6,300 tiny larvae in a glass petri dish are washed onto a small disposable paper tray containing freshly dispensed meat-blood media, measured volumetrically by an operator. The tray is sent down the roller conveyor to a second operator on the first conveyor line.

These trays, containing the larvae, are placed on the rack conveyor at the rate of 1.1 tray per minute. The design shows a full length continuous conveyor for the first line, although a much shorter line will actually be necessary. The line was designed for 1 tray per shelf in the rack containing 20 shelves. In this rack, only the lower 15 shelves will be used. The trip through the incubator, maintained at 95 to 100° F. and 95 to 100% RH, is scheduled for 24 hours. The design allows for the possibility of changing the speed of the conveyor line to suit the requirement as needed.

A third operator transfers the 24-hours-old larvae to one end of an intermediate-sized tray containing more fresh media. The small used tray is dropped through a funnel to a disintegrator, and carried by a screw-type of conveyor to either a Dumpster for disposal at a rendering plant or an incinerator or a drum dryer at the rear of the building. The second tray is placed on a shelf of the rack in the second line. The entire shelf will be used for the trays and the full line utilized. The trays are handled at the rate of 1.1 per minute allowing the operator 13.6 minutes to fill a rack. The rack is scheduled to move at a rate of 0.14 feet per minute. Therefore, the rack moves 1.9 feet during filling. After 24 hours, or 48 hours since the process began, the larvae are again transferred to a large disposable tray containing fresh media. The spent media and the intermediate tray are disposed of in a similar manner as the small tray.

The fourth operator places the large tray in the rack of the third line for 24 hours additional incubation.

After a total of 72 hours and at the end of the third line, a fifth operator transfers the large tray to the fourth line after adding some additional fresh media. About half-way through the fourth line (84 hours) the larvae begin to crawl out of the media seeking dry, dark, and firm conditions. The self-harvest takes place by the larvae falling from the trays into a long trough, directly underneath the rack, at the bottom of which is located a fast moving belt conveyor.

A sixth operator transfers the large tray to the fifth line which is also equipped with a trough and a fast moving conveyor. The larvae are spray washed and then dumped into a chute feeding a bucket-lift conveyor which transports them overhead, across the hall, into the pupation room. Most of the larvae crawl out of the media in the fifth line by the 108th hour. The rack plus the large tray return to the media dispensing room. The tray plus spent media is disposed of through a disintegrator and screw conveyor.

Disposable trays are used for at least three reasons: (1) reduction of initial capital cost, (2) minimizing number of employees which would be needed for the tray washing operation, and (3) to minimize the danger of spreading disease among the flies.

5. Pupation Room

It is proposed to feed the larvae plus soil or sand to the top of a wide conveyor. After six hours some of the larvae have pupated and the entire mixture is dumped into one of three series of sanitary circle sifters. These would be shaken intermittently, separating the pupae from the larvae-sand mixture. The larvae continue to pupate as they progress through these sifters during the next 18 hours. The pupae are collected in a dispenser or counter used to fill a disposable paper tube (12 in. l. by 2- $\frac{1}{2}$ in. dia.) with screened ends. Each tube contains 1,000 pupae. The sand is lifted by a conveyor, treated if necessary and reused. The temperature in the room is maintained at 80° F. and 100% RH. Adequate ventilation will be provided to remove the odor and ammonia.

These tubes are stored in a rack on a continuous conveyor similar to the ones used in the incubator. Each rack will contain 200 tubes. The live storage of the pupae in the tubes is scheduled for 5 days.

Two operators are used in this room. The second operator removes the tubes at the end of the fifth day at a rate of 5 tubes per minute, pours contents of 8 holding tubes into 1 tube for radiation, and sends them to the radiation room on a chute.

Approximately three stationary racks with pupae in the tubes are stored in these environmental conditions. These are held for two additional days or until the flies begin to emerge. The tubes are then carried to the adult colony room in the laboratory area for restocking the colony.

6. Radiation Building

This separated building contains 23 cobalt-60 irradiation units similar in design to the one installed in Orlando. However, these will be made with both ends open and mounted horizontally in series. The installation will include proper sealing of the junction between each unit. The ends of the room will be protected by an appropriate shield. The tubes are picked up on a wire conveyor carrying through all the units receiving a total of 36 minutes irradiation. Since the radioactive source occupies one-half of the length of the units the conveyor runs the tubes through in 79 minutes. It is not expected that operators will be located in this room. Despite the safe working conditions in the room, the only monitoring will be through the use of a closed-circuit industrial TV camera at the feed end of the units. The receiver can be located in any of several rooms.

7. Packaging and Shipping

The tubes containing 8,000 irradiated pupae are emptied into a small chambered funnel-dispenser. This sub-divides the pupae into quantities of about 130 in number. They are then dropped into the dispersal containers.

The number of packaging lines have not been determined since the type or shape of the container has not been determined. However, seven operators per shift are scheduled in this area. The individual

containers need to be filled at a rate of 38 per minute. The containers are then packed in cartons ready for shipment to the dispersal area.

8. Laboratory

About 2% of the total production of pupae is recycled back to the laboratory for restocking the fly colony. These pupae are kept an additional 2 days beyond the 5 day live storage in the pupation room in order to be held at 80° F. and 100% RH. The flies emerge about the end of this time and are then transferred to the adult colony room. Here the temperature is maintained at 80° F. and the RH at 80%. One thousand pupae and flies are emptied by the technician from the tube into a disposable cage. A mixture of meat and honey is provided on the first day along with water on a sponge or moist cotton. On the fourth day the original media is replaced by honey on oat hulls or on bran along with water. These cages are carried on roller-type conveyors. About 4.2 cages per hour will be processed through this room into the "egging" room. The adult flies will be 8 days old when they reach this room.

Fresh meat is provided on which the female flies lay their eggs. Approximately 200 eggs are laid in shingle-like masses. This step requires a maximum of two hours. The eggs are picked off and enough gathered on a balance to total 6,300 eggs. They are placed on moist filter paper and then put into a petri dish. These are placed in the double-ended incubator and maintained at 80 to 85° F. and 100% RH for 12 to 24 hours. The eggs hatch into tiny larvae ready to start the larvae cycle in the incubation room.

Separate and complete facilities for maintaining 20,000 adult flies, producing 2,000,000 eggs per week are located some distance away from the main plant. This will provide a source of new flies or eggs in case of disease, start new strains, etc., for the production unit.

9. Dispersal

The dispersion design and costs are contained in the "Preliminary Statement on Operational Plan and Cost Estimates" prepared by Entomology Research Branch, April 19, 1956.

SECTION III. MATERIAL BALANCE

This section includes four charts concerned with the material balance of Project Screw-Worm: (1) Material Flow Sheet, (2) Material Balance-Overall, (3) Material Balance-Unit, and (4) Capacity and Rate Chart.

Separation Sheet

Collection Name: Southeast United States: Screwworm Eradication Program
Records

Item: Project Screw-Worm Process Flow Sheet

Original location: Box 8, Folder 286 – Project Screw-Worm Redesign Concepts for
the Rearing of 50 Million Flies Per Week, ENCR No. 9

Subject/Series: II.C – Report

New location: Oversize, Box 10, Folder 361 – Project Screw-Worm Redesign
Concepts for the Rearing of 50 Million Flies Per Week, ENCR No. 9

OUTPUT: Flies (In Pupae Stage) for Shipping

50,000,000 Flies X 75 mgm/Fly (0.075 gm = 0.000165 lb.)

= 8,250 lb

@ 10 Pupae/cc = 5,000,000 cc = 1,320 gal.

Waste Media = 145,564 lb.

Ratio: Wgt of Media: Wgt of Fly Shipped = 18.6:1

Blood				
To tray	11,100	1,200	13,350,000	355
			1.06	31,000
TOTAL			355	31,000
Honey				
To cage	707	50	35,350	9.3
To cage	707	30	51,210	2.6
To trays	385,000	1.3	200,000	135
TOTAL			146.3	1,335
Water				
To tray	11,100	2,400	28,840,000	7050
			1.0	58,600
TOTAL			7050	58,600
Potash				
To tray	11,100	15	194,000	35.3
			0.9175	570
TOTAL			35.3	570
GRAND TOTAL				
			67,467,310	17,623
			1.03	153,814
				68,900

3. Material Balance - Unit

Basis: 50,000,000 Pupae Shipped (1 week's production)

INPUT

To Cage	No. Units	Quantity cc/Unit	Volume cc	Gal	Sp.Gr.	Weight lb.
Meat	707	50	35,350	9.3	1.05	81
Honey	707	50	35,350	9.3	1.42	110
			TOTAL	56.1		191
<u>To Cage</u>						
Honey	707	30	21,210	5.6	1.42	66
			TOTAL	5.6		66
<u>To Cage</u>						
Meat	707	200	141,400	37.5	1.05	327
			TOTAL			327
<u>To Trays</u>						
Meat	11,100	2,400	26,640,000	7050	1.05	61,800
Blood	11,100	1,200	13,320,000	3525	1.06	31,000
Water	11,100	2,400	26,640,000	7050	1.0	58,600
Formalin	11,100	12	134,000	35.3	0.9172	270
			TOTAL	17,660.3		151,670
<u>To Bags</u>						
Honey	385,000	1.3	500,000	132	1.42	1,560
			TOTAL	132		1,560
GRAND TOTAL			67,467,310	17,853	1.03	153,814

OUTPUT: Flies (in pupae stage) for shipping

$$(50,000,000 \text{ Flies} \times 75 \text{ mgm/Fly} \times (.075 \text{ gm} = 0.000165 \text{ lb}))$$

$$= 8,250 \text{ lb}$$

Moisture Loss During
Pupation (Assumption) 0

$$\text{Waste Media} = 145,564 \text{ lb.}$$

$$\text{TOTAL} = 153,814 \text{ lb.}$$

4. Capacity and Rate Chart

Basis: 50,000,000 Pupae Shipped (1 week's production)

	NUMBER PER			
	Minute	Day	Week	Year
Egg Laying	7,070	10,100,000	70,700,000	3,700,000,000
Eggs Hatched	6,700	9,600,000	67,000,000	
Larvae Reared & Harvested	5,370	7,600,000	53,700,000	
Larvae Pupated	5,080	7,200,000	50,800,000	
Pupae Held	5,080	7,200,000	50,800,000	
Pupae Radiated	5,000	7,100,000	50,000,000	
Pupae Packed	5,000	7,100,000	50,000,000	
Pupae Shipped	5,000	7,100,000	50,000,000	2,600,000,000
Bags Shipped (130/bag)	38	55,000	385,000	20,000,000
Trays Based on 6000 Hatched Eggs/Tray	1.1	1,590	11,100	577,000
Racks 15/Trays/Rack	Every 13.6 Min	106	670	

SECTION IV. PROPOSED PLANT LAYOUT

The Proposed Plant Layout for Project Screw-Worm is illustrated in this section.

Minutes	Day	Week	Year
Egg Laying	7,670	10,100,000	70,700,000
Egg Hatched	6,700	9,600,000	67,000,000
Larvae Hatched	5,370	7,600,000	53,700,000
Larvae Pupated	5,080	7,200,000	50,800,000
Pupae Held	5,080	7,200,000	50,800,000
Pupae Baled	5,000	7,100,000	50,000,000
Pupae Packed	5,000	7,100,000	50,000,000
Pupae Shipped	5,000	7,100,000	50,000,000
Eggs Shipped (100/box)	38	52,000	352,000
Trays Based on 6000 Hatched Eggs/Tray	1.1	1,190	11,100
Boxes 15/Tray/Box	13.6 Min	106	690

Separation Sheet

Collection Name: Southeast United States: Screwworm Eradication Program
Records

Item: Project Screw-Worm Proposed Plant Layout

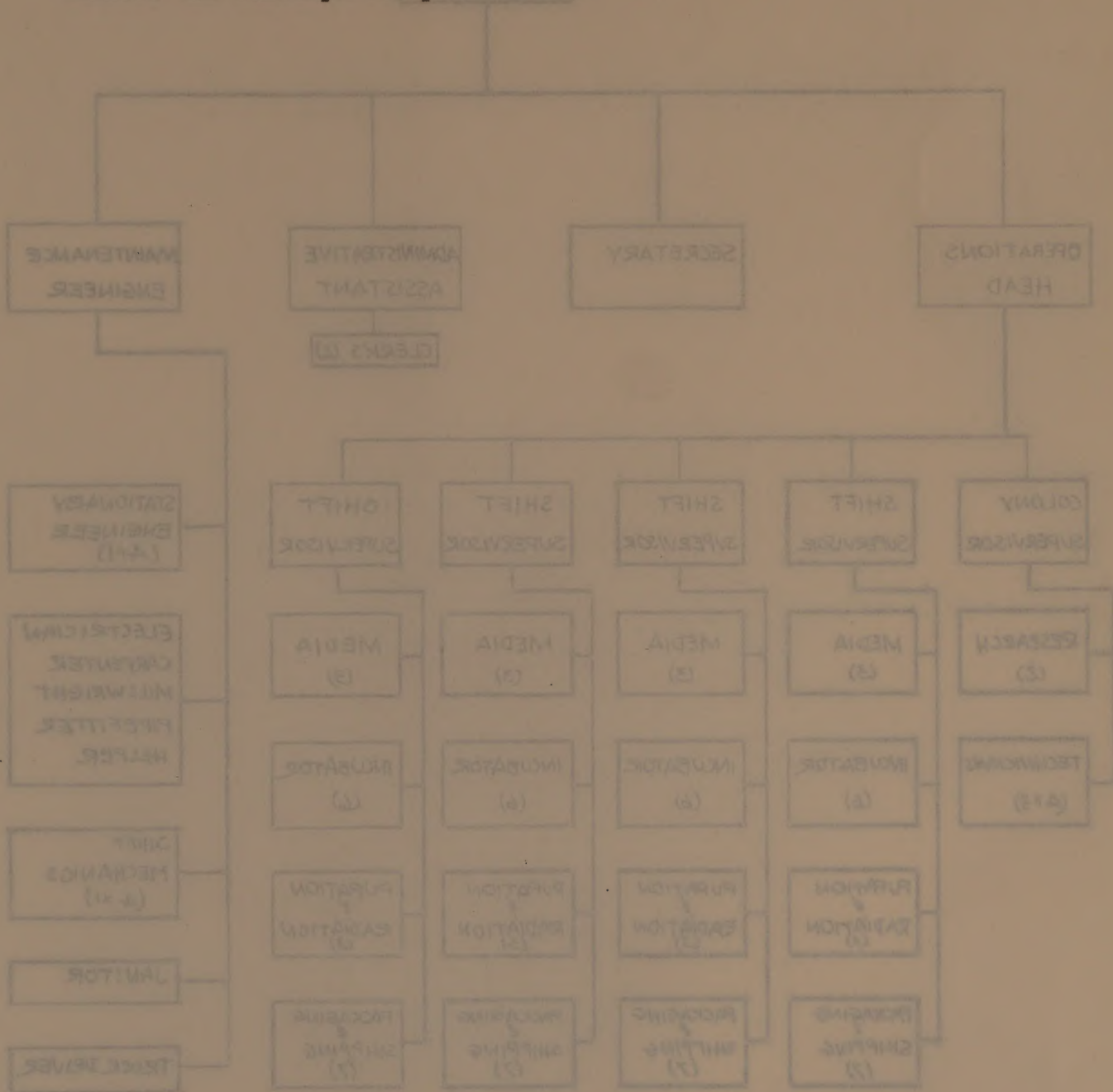
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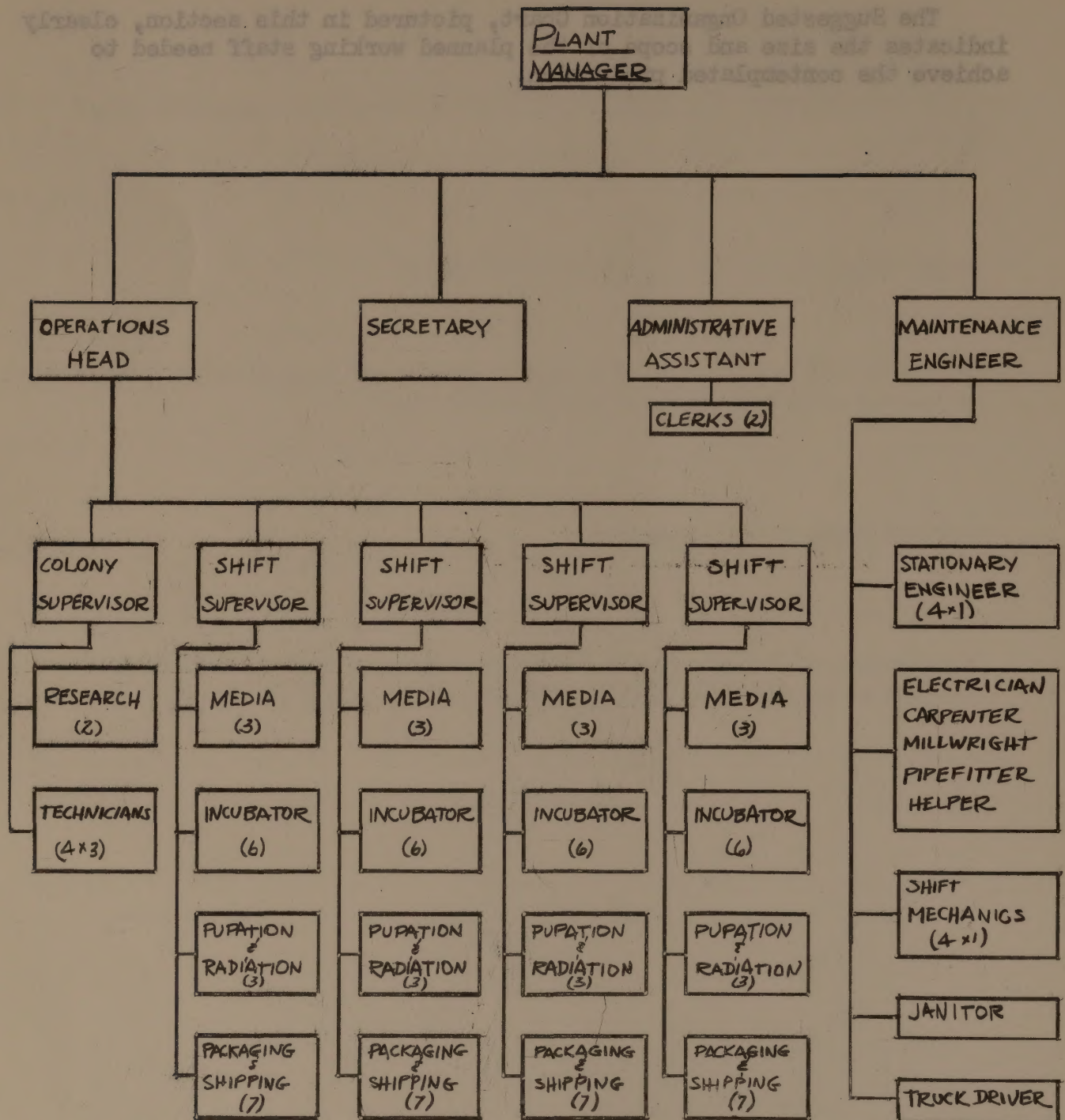
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SECTION V. SUGGESTED ORGANIZATION CHART

The Suggested Organization Chart, pictured in this section, clearly indicates the size and scope of the planned working staff needed to achieve the contemplated production.



TOTAL
DAYS
SHIFT (4-5)
117 EMPLOYEES
15 EMPLOYEES
100 EMPLOYEES



TOTAL	117	EMPLOYEES
DAYS	17	EMPLOYEES
SHIFT (4x25)	100	EMPLOYEES

SECTION VI. PREDESIGN COST ESTIMATE FOR SCREW-WORM CONTROL PROJECT

1. Summary

Basis: Two year operation; production and dispersal of 5,200,000,000 flies

ITEM	TOTAL COST	COST/ 1000 FLIES	%
Texas: Building & Real Estate	\$598,000	0.1151	9
Texas: Capital Equipment	902,000	0.1734	14
Texas: Raw Materials	1,420,000	0.2730	21
Texas: Supplies	834,000	0.1605	12
Texas: Utilities Expense	74,000	0.0136	1
Texas: Labor and Supervision	966,000	0.1858	14
Florida: Dispersal all inclusive	1,913,000	0.3679	29
TOTAL	\$6,707,000	\$1.2893	100
Escalation	\$ 238,000	\$0.0457	
Credits	\$ 221,000	\$0.0425	

2. Building and Real Estate

		UNIT COST	TOTAL COST	COST/ 1000 FLIES
a. <u>Buildings.</u>	25,000 ft ²	\$16	\$400,000	\$0.0770
b. <u>Auxiliary Facilities</u>				
land, fencing, roadways parking areas, drain- age, etc.			180,000	0.0346
c. <u>Outside Lines.</u>			18,000	0.0035
Total cost of Building and Real Estate			\$598,000	\$0.1151

3. Capital Equipment

PROCESS EQUIPMENT	EQUIP COST	INSTAL- IATION	TOTAL COST
2,000 Gal. Horizontal Blood Storage Tank (64"D X 12'L X 3/16" = 1950 lb.)			
304 SS for steaming			
No pressure. Insulation-150 ft ² @\$2/ft ²	\$5500	\$1800	\$7300
Ditto	5000	1800	7300
Lightnin' Agitator&Impellor for 2,000 Gal.	700	100	800
Ditto	700	100	800
Pump for Blood 20 GPM	100	50	150
Pump for Blood from Drums	100	50	150
Meter for Blood	100	50	150
500 Gal. Media Vessel (5'D X 4.5')			
Jacket-304 SS Clad-Pressure	3500	800	4300
Ditto	3500	800	4300
Lightnin' Agitator	900	100	1000
Ditto	900	100	1000
Meter for Water 167 Gal/5 Min	100	50	150
Pump for Media Food Type	100	50	150
Ditto	100	50	150
TCR For Media Vessel 60°F-170°F	500	100	600
Ditto	500	100	600
Valve for Warm Water Flow 140°F	100	50	150
Ditto	100	50	150
Balance 1000 lb.	300	-	300
Refrig. for Blood Storage Tank			
5 Ton Unit / Brine	3000	1400	4400
Cooling Coils for Above	100	100	200
Ditto	100	100	200
Refrig. for Meat Storage \$2/cu.ft.	11,000	5000	16,000
Pallets (40) @\$5	200	-	200
Balance 25 lb.	200		200
Conveyor Tables @\$200	1000		1000
480 Racks for Conveyors (15 Trays)	26,000		26,000
120 lb / 150 lb Media & Tray			
20 Spares; 15 Trays/Rack			
Conveyor System 5 X 250 Ft. Overhead	11,200	3800	15,000
For Live Storage: \$5/Pulley;4			
\$12/ft Steel & Chain			
Conveyor 50 Ft 6"D in Floor for Disposal of Tray & Spent Media	1300	700	2000

PROCESS EQUIPMENT	EQUIP COST	INSTAL- LATION	TOTAL COST
Disintegrator for Trays & Spent Media	300	100	400
Dempster Dumpster Bucket for Spent Media	500	--	500
Ditto	500	--	500
Ditto Empty & Trash	500	--	500
Truck for Dempster	3000	--	3000
Funnel, Al. 6 ft. wide x 125'	200	300	500
Ditto	200	300	500
Conveyor 125 ft. at Floor Level 6" Wide	1200	600	1800
Ditto (6" wide x 125' Long x \$2 = \$1500 (Motor \$300)	1200	600	1800
Bucket Lift Conveyor 10 ft. High	2000	500	2500
Conveyor 25 Ft.	350	150	500
Conveyor & Screening for Pupation	16,000	5000	21,000
Lift Conveyor for Sand	2000	500	2500
Soil Treatment	2000	500	2500
Sand Hopper & Feed Vibrator	1000	300	1300
Counter for Pupae	200	100	300
Conveyor for Live Pupae Storage, 90 ft.	1800	600	2400
Racks for Live Pupae Storage, 180	9000	--	9000
Tube Filler 1000/Tube 5.08 Min	1000	300	1300
Conveyors to & From Radiation Room	1000	400	1400
Conveyor Thru Radiation Room	300	100	400
TV Camera in Radiation Room	1000	100	1100
TV Receiver	400	--	400
23' Radiation Chambers @ \$4500	104,000	10,000	114,000
Tube Thru Chamber 3"D x 50' @ \$3/ft.	200	100	300
Bucket Lift Conveyor	2000	500	2500
Counter	200	100	300
Honey Dispenser	500	200	700
Excelsior Dispenser	500	200	700
Counting Machine	500	200	700
Bagging Machine (Mostly by Hand)	--	--	--
Conveyors - No Motors	2000	1000	3000
Packaging - Hand	--	--	--
Pallets 100 @ \$5	500	--	500
Conveyor in Adult Colony Room	500	200	700
Ditto	500	200	700
Ditto	500	200	700

PROCESS EQUIPMENT	EQUIP COST	INSTAL- LATION	TOTAL COST
5 Gal. Media Mix	300	100	400
Gas Chamber for Spent Adult Flies	300	100	400
Steam Boiler Cyclotherm	8000	2000	10,000
Ditto	8000	2000	10,000
Incubator 5 Sections & Racks	2000	1000	3000
Lab Benches	2350	1000	3350
Air Conditioning 12 x 3/4 Ton	3600	400	4000
Office Furniture	6000	400	6400
Lockers	3600	400	4000
Maintenance Shop	5000	1000	6000
Incubator Ventilation	2500	1000	3500
Ammonia Scrubber & Humidity Control	2400	1200	3600
Odor Removal - Carbon	3000	1000	4000
Ventilation for Pupae Room	2000	500	2500
Ventilation for Media Prep	2000	500	2500
Ventilation for Laboratory plus 10 Ton Air Cond.	5000	1000	6000
Incinerator or Drum Dryer	4000	2000	6000
1 Passenger Car	1350	--	1350
4 - 2 Ton Trucks for Meat Hauling	10,000	--	10,000
4 - Pickup Trucks	4400	--	4400
a. Equipment Costs	\$313,750	\$56,250	\$370,000
b. Process Piping			25,000
c. Instruments			7,000
d. Engineer, Construction			200,000
e. Contingencies			200,000
f. Size Factor			100,000
TOTAL CAPITAL EQUIPMENT COSTS			\$902,000

4. Raw Material

	Weight lb.	Unit Cost	Total Cost	Cost/ 1000 Flies
<u>a.</u> Meat, ground for cage	8,424	\$0.20	\$ 1680	\$0.0003
Meat, ground for cage	34,000	0.20	6800	0.0013
Meat, ground for trays	6,469,000	0.20	1,294,000	0.2488
<u>b.</u> Blood bovine	3,224,000	0.015	48,360	0.0093
<u>c.</u> Honey, for cage	11,440	0.37	4,240	0.0008
Honey, for cage	6,864	0.37	2,530	0.0005
Honey, for bags	162,240	0.37	60,000	0.0116
<u>d.</u> Formalin for trays	28,080	0.07	1,960	0.0004
Total Raw Material Costs			\$1,420,000	\$0.2730

5. Supplies

	Units			
<u>a.</u> Disposable cages	75,000	0.20	\$15,000	\$0.0029
<u>b.</u> Disposable paper dish	1,154,400	0.005	6,000	0.0012
<u>c.</u> Disposable trays small	1,154,400	0.01	12,000	0.0023
Disposable trays intermediate	1,154,400	0.03	35,000	0.0067
Disposable trays large	1,154,400	0.05	58,000	0.0112
<u>d.</u> Disposable holding tubes	5,283,200	0.05	263,000	0.0505
<u>e.</u> Dispersal containers	40,000,000	0.01	400,000	0.0770
<u>f.</u> Miscellaneous supplies			30,000	0.0058
<u>g.</u> Travel - Texas			15,000	0.0029
Total cost of supplies			\$834,000	\$0.1605

6. Utilities Expense

a. Maintenance

\$ 15,000

b. Water, cooling gal.	5,000,000	M \$ 0.10/gal	500
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c. Water, processing, labs, lockers, gal.	1,000,000	M 1.00/gal	1,000
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d. Fuel oil for hot water & heat, gal.	50,000	0.13/gal	6,500
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e. Electricity, power Kw-hr	1,800,000	0.02	36,000
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f. Electricity, lighting Kw-Hr	600,000	0.02	12,000
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g. Telephone			3,000
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TOTAL

\$74,000 \$0.0136

7. Labor and Supervision

Employees		Number	Annual Salary	Total Cost Per Two Years	Cost/ 1000 Flies
Plant Manager	GS-14	1	\$10,320	\$20,640	\$0.0040
Operations Head Engr.	GS-13	1	8,990	17,980	0.0035
Colony Supervisor Ent.	GS-11	1	6,390	12,780	0.0024
Entomologist	GS-9	1	5,440	10,880	0.0021
Technicians	GS-7	13	4,525	117,650	0.0226
Shift Supervisors	GS-9	4	5,440	43,520	0.0084
Operators	WB	76	3,500	532,000	0.1023
Maintenance Engr.	GS-11	1	6,390	12,780	0.0024
Stationary Engr.	WB	4	4,500	36,000	0.0069
Mechanics Day	WB	5	4,500	45,000	0.0086
Shift Mechanics	WB	4	4,500	36,000	0.0069
Janitor	WB	1	3,000	6,000	0.0012
Truck Driver	WB	1	4,000	8,000	0.0015
Secretary	GS-5	1	3,670	7,340	0.0014
Administrative Asst.	GS-12	1	7,570	15,140	0.0029
Clerks	GS-5	2	3,670	14,680	0.0028
	43%	—	—	29,610	0.0058
TOTAL		117	\$ 4,120	\$966,000	\$0.1858

8. Dispersal - All Inclusive

From report by

Entomology Research Branch

April 19, 1956

a. Salaries.

Program Direction

Entomologist	GS-14	1	\$10,320	\$ 20,640	\$0.0040
Entomologist	GS-13	1	8,990	17,980	0.0035
Secretary	GS-5	1	3,670	7,340	0.0014

Fly Detection

Entomologist	GS-12	1	7,570	15,140	0.0029
Entomologist	GS-9	2	5,440	21,760	0.0042
Agent-Field Aid	GS-7	25	4,525	226,250	0.0435

Administrative Office

Assistant (Florida)	GS-9	1	5,440	10,880	0.0021
Clerk-Typist (Florida)	GS-4	1	3,415	6,830	0.0014

Fly Dispersal Project

Aircraft Specialist	GS-12	1	7,570	15,140	0.0029
Aircraft Specialist	GS-11	1	6,390	12,780	0.0024
Aircraft Specialist	GS-7	7	4,525	63,350	0.0122
Truck Driver	GS-5	4	3,670	29,360	0.0056
Increases	43%	--	--	13,050	0.0026

TOTAL-SALARIES		46		\$460,500	\$0.0887
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b. Office and Working Space - Florida.

\$32,000 \$0.0062

TOTAL OFFICE

\$32,000 \$0.0062

c. Supplies and Equipment.

Passenger Cars (Hq)	3	\$1,330	\$ 4,000	\$0.0008
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Pickup Truck	1	1,100	1,100	0.0002
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Trucks (Fly Dispersal)	4	2,500	10,000	0.0019
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Pickup Truck (Survey)	25	1,100	27,500	0.0053
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Automatic Dispersal Devices for Airplanes	---	-----	12,000	0.0023
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Air Conditioners for Fly- holding Rooms & Trucks	---	-----	4,400	0.0008
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Gas, Oil & Maintenance of Automotive Equipment	---	-----	39,000	0.0075
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Miscellaneous	---	-----	45,000	0.0086
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Travel Florida	---	-----	50,000	0.0096
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TOTAL SUPPLIES			\$193,000	\$0.0370
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d. Contracts.

30 Airplanes @ \$10/hr to cover 60 sectors, est.	50,000 sq. miles	\$1,000,000	\$ 0.192
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Air Shipment of Pupae Texas-Florida		227,500	0.044
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TOTAL CONTRACTS		\$1,227,500	\$0.2360
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TOTAL DISPERSAL		\$1,913,000	\$0.3679
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9. Escalation

Present rate of rise as indicated in Engineering News-Report is 3.6% per year. If construction begins one year from now and operations begin a year and a half from now the following additional costs can be expected:

	<u>Additional Cost</u>	<u>Cost/1000 Flies</u>
Building and Real Estate	\$ 22,000	\$0.0042
Capital Equipment	32,000	0.0061
Operations	115,000	0.0222
Raw Materials		
Supplies		
Labor & Supervision		
Florida Dispersal	<u>69,000</u>	<u>0.0132</u>
TOTAL ESCALATION	\$238,000	\$0.0457

10. Credits

a. Waste Media - assume material could be dried to 20% of original weight by the use of a drum dryer. Disposable trays will be mixed in with media but will not be considered in the weight.

Weight of Wet Media	15,140,000 lb.	
Weight of Dried Media	3,028,000 lb	
Value @ 3¢ per lb.	\$ 90,000	\$0.0173
<u>b.</u> Resale Value of Equipment	31,000	0.0060
Using 10% of Original Price		
<u>c.</u> Resale of Building	<u>100,000</u>	<u>0.0192</u>
Using 25% Realized at		
End of Project		
TOTAL CREDITS	\$221,000	\$0.0425

SECTION VII. SUGGESTED PROBLEMS FOR ENGINEERING ANALYSIS

1. Raw Materials

a. Cost of ground meat is \$0.2488 per 1000 flies, contributing 19-20% to the total cost of project or 46-47% to the operating cost.

b. Suggestions for improvement in cost include:

Substitutions such as meat extracts, soy bean meal, etc;

Fillers such as sawdust, oat hulls;

Better utilization of material by feeding only that amount actually utilized by the larvae;

Better utilization by spraying on the media;

Better utilization by feeding from the underside;

Use of chemicals to reduce decomposition;

2. Yields

Largest loss in the production is in the rearing step. In this step 67,000,000 hatched eggs per week are fed in the incubator room which nets 53,700,000 larvae per week or 80% recovery. Each 1% gain in yield would decrease the operating cost of the plant by about \$10,000.

3. Location of Plant in Florida

Balancing flight transportation cost versus adequate building design plus transportation of raw material cost.

4. Reduction of Personnel

a. Reduction of number of personnel by mechanizing the packaging operation.

b. The design includes the utilization of 7 employees per shift. Reduction of one employee per shift reduces cost by \$28,000 for direct labor over a two year period.

5. Waste Disposal

Either of two methods could be used for disposal of the spent nutrient. Burning in an incinerator would result in a small volume of ash for disposal. If a market is available for a fertilizer mixed with paper pulp, then drum drying would be the method of disposal.

SECTION VIII. PROJECT ENGINEERING PLAN

This section contains a Phase Schedule and Budget Requirements Chart for Project Screw-Worm.

1. Improvements for improvement in cost reduction

1.1. Reduction of cost of material, labor, and overhead

1.2. Reduction of cost of material, labor, and overhead

1.3. Reduction of cost of material, labor, and overhead

1.4. Reduction of cost of material, labor, and overhead

1.5. Reduction of cost of material, labor, and overhead

1.6. Reduction of cost of material, labor, and overhead

2. Design

2.1. Design of the production line. The design of the production line is the most important factor in the cost of the product. The design of the production line should be such that it will allow for the most efficient use of the available space and equipment. The design of the production line should also be such that it will allow for the most efficient use of the available labor and material.

3. Location of Plant in Florida

3.1. Location of the plant in Florida. The location of the plant in Florida is a very important factor in the cost of the product. The location of the plant should be such that it will allow for the most efficient use of the available space and equipment. The location of the plant should also be such that it will allow for the most efficient use of the available labor and material.

4. Reduction of Personnel

4.1. Reduction of number of personnel. The reduction of the number of personnel is a very important factor in the cost of the product. The reduction of the number of personnel should be such that it will allow for the most efficient use of the available space and equipment. The reduction of the number of personnel should also be such that it will allow for the most efficient use of the available labor and material.

4.2. The design includes the utilization of the available space and equipment. The design of the production line should be such that it will allow for the most efficient use of the available space and equipment. The design of the production line should also be such that it will allow for the most efficient use of the available labor and material.

BW PLANTS DIVISION

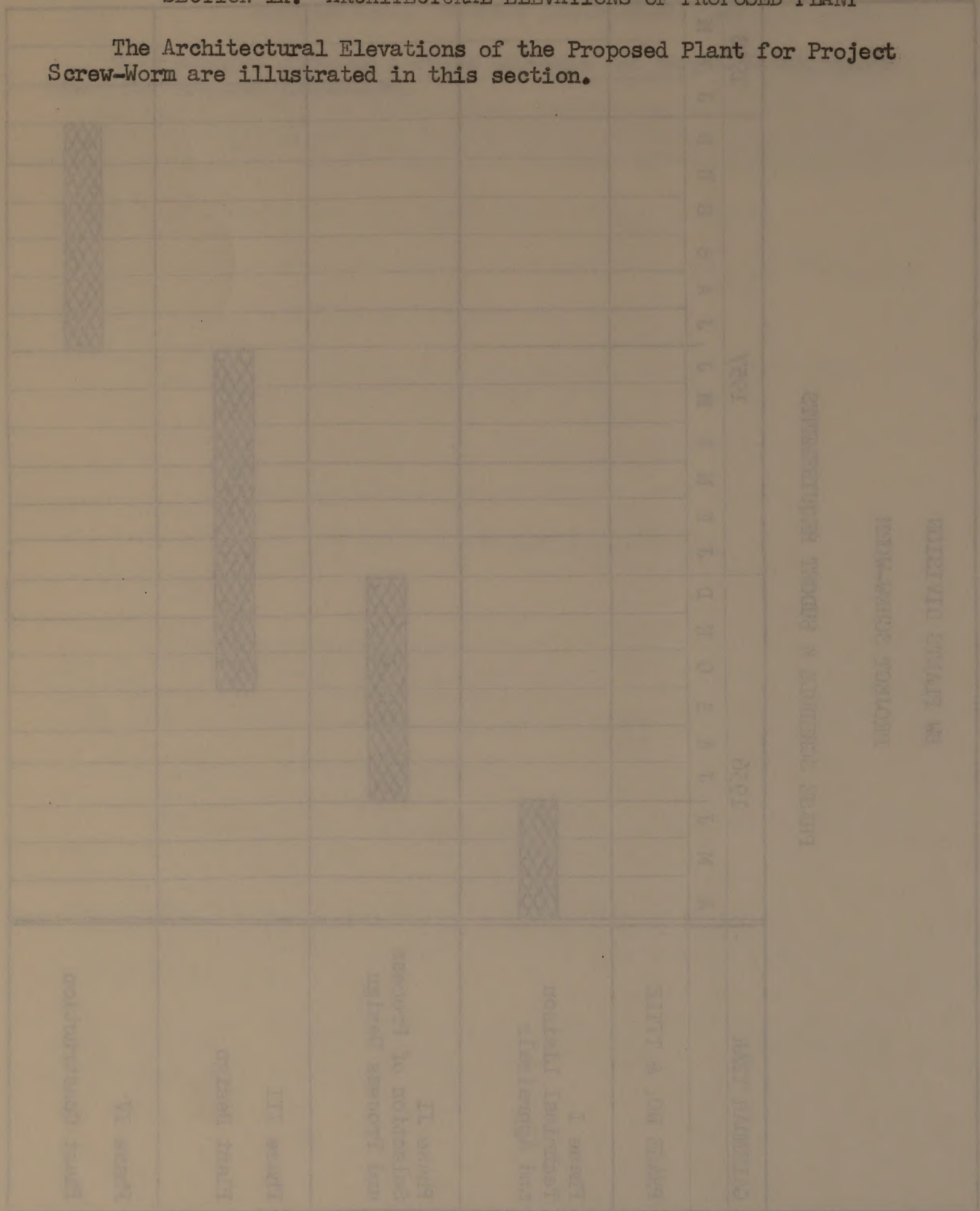
PROJECT SCREW-WORM

PHASE SCHEDULE & BUDGET REQUIREMENTS

CALENDAR YEAR	1956												1957												1958		
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M			
PHASE NO. & TITLE																											
Phase I Technical Liaison and Appraisals																											
Phase II Selection of Process and Process Design																											
Phase III Plant Design																											
Phase IV Plant Construction																											

SECTION IX. ARCHITECTURAL ELEVATIONS OF PROPOSED PLANT

The Architectural Elevations of the Proposed Plant for Project Screw-Worm are illustrated in this section.



Separation Sheet

Collection Name: Southeast United States: Screwworm Eradication Program
Records

Item: Project Screw-Worm Building Elevations

Original location: Box 8, Folder 286 – Project Screw-Worm Redesign Concepts for
the Rearing of 50 Million Flies Per Week, ENCR No. 9

Subject/Series: II.C – Report

New location: Oversize, Box 10, Folder 361 – Project Screw-Worm Redesign
Concepts for the Rearing of 50 Million Flies Per Week, ENCR No. 9

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